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ABSTRACT

Efforts are currently underway to adjust the focus of industrial arts instruction to concentrate more on the study and understanding of technology and its role in our lives. For many years industrial arts programs have been industry-based; however, many professionals support a curriculum that will relate industrial arts instruction more closely to the contemporary world by shifting the focus to technology itself. To help educators understand the structure and implementation of a technology education, specifics are provided for each school level that include goals, program descriptions, outcomes, and courses. Charts show the recommended scope and sequence. Brief descriptions of what five other schools are already doing and a list of seven annotated sources of information are appended. (MLF)

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Curriculum Report

Vol. 14 No. 4 April 1985

# Technology Education: A Modern Focus for Industrial Arts

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# Technology Education: A Modern Focus for Industrial Arts

Readers who have taken a careful look at today's industrial arts courses and programs are probably surprised that they are very different in focus and content from the courses they may have taken in their middle and high school years. And more changes are in process; efforts are currently under way to adjust the focus of industrial arts instruction in the schools to concentrate more on the study and understanding of technology and its role in our lives during the final years of the 20th Century.

This *Curriculum Report* considers *the nature and some of the consequences of this movement to transform industrial arts education into technology education.*

## The Past Is Prologue

This movement is only the most recent step in an essentially orderly evolution of an industrial arts curriculum that will reflect the character and serve the needs of the society in which it exists. A brief review of that curriculum evolution, especially in the last 40 years, will show that the recommendation to convert industrial arts education to technology education is consistent with the history of this instructional field.

Changes that the American Industrial Arts Association (AIAA) has made in the title of its monthly journal provide a framework for this review, for they are like signposts along this curriculum road.

The early years of this century saw manual *training* and then manual *arts*. But the 1930s witnessed a shift in focus from *manual* arts to *industrial* arts. That change in purpose and subject matter had far-ranging and long-lasting effects on programs in the schools. It was natural, then, that when the American Industrial Arts Association was formed in 1939 its journal should be titled *The Industrial Arts Teacher*.

In 1963 that title was changed to *The Journal of Industrial Arts Education*. Not much of a change, it might seem, but behind it was the profession's growing awareness of the significance of the emerging space-age technology and other societal changes to industrial arts curricula.

This awareness sharpened and expanded until it became evident that the comprehensiveness of the Association's interests, and of the profession as a whole should be reflected in the title of the journal.

In the fall of 1970, the publication became known as *Man/Society/Technology*. In the first issue under the new name, the editor wrote, "The name change has not been made merely for the sake of change, but rather in response to a continuing effort to meet the needs of society."

During the 1960s and '70s, as curriculum developers became more sensitive to the increasing complexity of our technological society and to the need for greater occupational information in order to understand and properly interpret the role of industry in today's world, numerous proposals were made for updating industrial arts instruction. The literature of those years reveals references to more than 35 innovations which, for the most part, emphasized industry and technology as the dominant goal of industrial arts instruction.

For many years industrial arts programs have been built around broad occupational areas such as metalworking and printing. Many such *industry-based* shop programs have been replaced or substantially modified because they tend to focus on specific occupational skills to the exclusion of a more comprehensive study of industry as a whole. That replacement has taken several forms, but probably the most popular pattern at the moment, at least at the middle school level, is the study of *industrial clusters*, which provides a broad, integrated view of the industrial/technical aspects of American society. This approach is exemplified by a curriculum developed during the 1960s by the Industrial Arts Curriculum Project (IACP) at The Ohio State University.

The IACP studied industrial technology, which was defined as "that knowledge which is used to satisfy man's wants for industrial material goods, and it is composed of two principal industrial divisions — construction and manufacturing." IACP developed and carefully field-tested two, year-long middle school-level courses: The World of Construction, and The World of Manufacturing.

Both courses extensively use group-learning activities as opposed to the individual projects typical of most traditional courses. Students in The World of Construction are involved with the sequential activities common to building *any* structure, such as surveying, sketching plans, addressing topological problems, applying building codes, and planning for the community. In The World of Manufacturing, planning a production line for a

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mass-produced product is a theme that leads to the study of related matters such as marketing, logistics, packaging, personnel organization, and labor-management relations.

Curriculum changes in the schools do not always take the exact form recommended by curriculum designers, and industrial arts teachers tend to be eclectic in structuring their programs by selecting elements from suggested instructional patterns. But *the profession increasingly favors programs and courses that emphasize the technical aspects of American industry and society.*

## Another Change on the Horizon

Today, in the ranks of AIAA and in the profession as a whole, support is growing for a curriculum that will relate industrial arts instruction more closely to the contemporary world by *shifting the focus to technology itself.* Its judgment that technology education is the "wave of the future" led AIAA to update the name of its journal in the fall of 1983 to *The Technology Teacher.*

The wisdom and practicality of changing the focus of industrial arts education are topics of lively debate in industrial arts circles — not only among teachers and supervisors, but among curriculum theorists as well. A major handicap to evaluating this proposal and estimating its impact on school practices has been, for most educators, a foggy understanding of the structure and implementation of a technology education curriculum.

School principals and their administrative associates need a clearer understanding if they are to be effective instructional advisers to their industrial arts staff members. Therefore, the remainder of the *Curriculum Report* will, it is hoped, provide at least some of the needed clarification by giving some of those "operating specifics," with brief descriptions of what a number of schools are already doing about technology education.

In January 1985, the American Association of Industrial Arts distributed to its members a 36-page monograph entitled, *Technology Education: A Perspective on Implementation.* One chapter of the monograph discusses possible course patterns and other details of technology education at various school levels. That chapter, with minor modifications to fit the *CR* context, is reprinted here. The Exempli Gratia also draw on material from the monograph.

## A Pattern for Technology Education*

Because the American culture is distinctly characterized as technological, it becomes the function of schools to give every student an insight and understanding of the technological nature of the culture. This is what the program of technology education strives to do. It acquaints all persons with their technological environment so they can make rational decisions about their own lives on a day-to-day basis and participate in controlling their own destiny.

> *Technology Education — a comprehensive action-based educational program concerned with technical means, their evolution, utilization, and significance; with industry, its organization, personnel, systems, techniques, resources, and products; and their social/cultural impact.*

Recognizing the individual's native potential for reasoning and problem solving, for imagining and creating, for constructing and expressing with tools and materials — from which technology and industry spring forth — technology education capitalizes on this rich potential and develops content and experiences to contribute to the growth and development of human beings commensurate with their potential. Thus, technology education is a basic and fundamental study for all persons, regardless of educational or career goals. Technology education can help the student to:

- know and appreciate the importance of technology.
- apply tools, materials, processes, and technical concepts safely and efficiently.
- uncover and develop individual talents.
- apply problem-solving techniques.
- apply other school subjects.
- apply creative abilities.
- deal with forces that influence the future.
- adjust to the changing environment.
- become a wiser consumer.
- make informed career choices.

## Criteria for a Technology Education Program:

At all levels the program/course content is based upon. . .

1. an organized set of concepts, processes, and systems which are uniquely technological.
2. fundamental knowledge about the development of technology and its effect on people, the environment, and culture.
3. instructional content drawn from one or more of the following areas:
   (a) communication — efficiently utilizing resources to transfer information to extend human potential;
   (b) construction — efficiently utilizing resources to build structures or constructed works on a site;
   (c) manufacturing — efficiently utilizing resources to extract and convert raw/recycled materials into industrial and consumer goods; or
   (d) transportation — efficiently utilizing resources to obtain time and place utility and to attain and maintain direct physical contact and exchange among individuals and societal units through the movement of materials/goods and people.
4. assisting students in developing insight, understanding, and application of technological concepts, processes, and systems.
5. applying tools, materials, machines, processes, and technical concepts safely and efficiently.

*Adapted from Section 3, *Technology Education: A Perspective on Implementation,* copyright 1985, American Industrial Arts Association, 1914 Association Drive, Reston, Va. 22091. Reprinted by permission.

6. developing student skills, creative abilities, positive self-concepts, and individual potential in technology.
7. developing student problem-solving and decision-making abilities involving human and material resources, processes, and technological systems.
8. preparing students for lifelong learning in a technological society.
9. activity-oriented laboratory instruction with students reinforcing abstract concepts with concrete experiences.
10. a combined emphasis on "know-how" and "ability to do" in carrying out technological work.

Technology education should be implemented at all levels in the schools. A model for the curriculum structure is shown in this chart.

| | |
|---|---|
| *High School* (Grades 9-12) | *Goal:* Preparation in Technology |
| *Middle/Junior High School* (Grades 6-9) | *Goal:* Orientation and Exploration |
| *Elementary School* (Grades K-6) | *Goal:* Learning Reinforcement and Technical Awareness |

Following are more of the specifics of this structure at each school level.

## Elementary School

*Goal:* To provide learning reinforcement that contributes to the pupil's personal development and technological awareness.

*Description:* Elementary school technological education experiences are designed to assist in the attainment of educational goals of the total elementary school program. These experiences orient students to technology, develop personal psychomotor skills and refine attitudes toward technology's influence on society. Technology education activities should be integrated into the total elementary school curriculum, and these activities should provide students with experiences that reinforce this curriculum.

More specifically, technological education at the elementary school level:

- provides opportunities for children to learn fundamental concepts on how people create and control their environment;
- reinforces and enriches concepts in the sciences, mathematics, language arts, and other subject areas in the elementary school curriculum;
- allows students to work with tools, materials, and technological concepts and processes;
- develops technological awareness.

## Middle/Junior High School

*Goal:* To assist students in making meaningful educational and occupational choices.

*Description:* The technological education program at this level is exploratory in nature. At the middle and junior high school, students investigate and examine four broad content areas of technology education: communication, *construction, manufacturing,* and *transportation.*

It is recommended that *all students* take technology education at this level whether they have future education plans to enter college or to pursue a vocation, and regardless of their career goals. Technology education courses at the middle or junior high school level should be designed to lead into a well-articulated series of courses at the senior high school and post-secondary levels.

As a result of taking technology education at the middle school or junior high school level, all students can begin to develop their innate talents, attitudes, and skills to better live in our technological world. Problem solving, career orientation, and learning for tomorrow's adaptive environment are cornerstones of the technology education program at the middle school or junior high school.

*Outcomes:* As a result of taking technology education, junior high school students will:

- appreciate the scope of contemporary technology;
- safely use basic tools, machines, materials, and processes associated with technology;
- identify occupational fields and educational programs in technological career fields. Study and analyze the materials, products, processes, problems, uses, developments, and contributions of these related career fields;
- experience the organization and management systems of business and industry;
- research, plan, design, construct, and evaluate problems and projects common to technological career fields.

*Courses:* At the middle/junior high school level, every student should be *required* to take a one-semester course in "Introduction to Technological Systems." In this course the four technological areas — communication, construction, manufacturing, and transportation — are broadly presented.

After a middle school or junior high school student takes "Introduction to Technological Systems," he or she can elect to take any or all of the four individual technology education courses that will be available. These semester courses are Communication Systems, Construction Systems, Manufacturing Systems, and Transportation Systems, and they provide the student with a more in-depth orientation to these technological areas from a systems perspective.

The chart shows the recommended scope and sequence of the middle school or junior high school technology education courses.

| GRADES | RECOMMENDED COURSES | TYPE OF COURSE |
|---|---|---|
| 8-9 | Communication Systems<br>Construction Systems<br>Manufacturing Systems<br>Transportation Systems | Elective courses, each a semester in length. |
| 6-7 | Introduction to Industrial and Technological Systems | Required course, a semester for all students |

## Senior High School

*Goal:* To prepare students for collegiate and/or advanced vocational/technical programs and to be equipped with universally transferable technological skills.

*Description:* The senior high school technological program is designed to provide students with an in-depth foundation for career preparation at the secondary or post-secondary levels. Students will gain an adaptability leading to consumer awareness and personal enrichment as well as occupational readiness.

Students pursuing engineering and scientific careers in college will gain much from taking certain technological education courses. Also, students will develop transferable skills for work as well as for further education.

*Outcomes:* As a result of taking technological education, senior high school students will:

- experience the practical application of basic scientific and mathematical principles;
- make decisions regarding post-secondary technology careers, engineering programs, or service-related fields;
- make decisions with regard to advanced vocational education programs;
- gain an in-depth understanding and appreciation for technology in our society and culture;
- develop basic skills in the proper use of tools, machines, materials, and processes;
- solve problems involving the tools, machines, materials, processes, products, and services of industry and technology.

*Courses:* There should be courses in the high school which reflect each of the four basic areas of technology education. These course offerings should be articulated with earlier course offerings in middle and junior high schools and designed to complement them. Since each of the senior high school courses will be elective in nature, the significance of the guidance counselor's role is clear. The accompanying chart shows recommended course titles/topics for senior high technology education courses.

*Facilities:* Moving from a traditional industrial arts program to technology education will require a modest shift in the laboratory settings and in the apparatus to equip the facility. Initially, the program can be taught in existing facilities by using the tools and machines that are in place. How and when that equipment is used will change as the new program is put in place.

As the program develops, it will call for the use of microcomputer applications and such equipment as small tabletop robots, laser experiments, fiber optics, energy stations, and other high-tech trainers. When

**Recommended Senior High School Courses in Technology Education**

| GRADES | COURSE | TYPE OF COURSE |
|---|---|---|
| 9-12 | Communication:<br>Graphic Communications Systems<br>Electronic Communications Systems<br>Media Communications Systems | Elective Courses one or two semesters in length |
| | Construction:<br>Construction Planning & Design<br>Constructing & Servicing Structures<br>Electro/Mechnical Systems & Servicing | |
| | Manufacturing:<br>Manufacturing Materials & Processes<br>Designing Products for Manufacture<br>Manufacturing Production Systems | |
| | Transportation<br>Technical Elements Transportation<br>Planning & Designing Transportation<br>Human & Goods Transportation Systems | |

these units are complemented with regular equipment, many possibilities emerge. The mix of equipment will require a variety of single items and less duplication of any single item.

*Career Paths for Graduates:* Students who go through an articulated technology education program should be prepared for any one of three possible career goals as they graduate from high school:

The student may wish to enter college as an engineering, scientific, architectural, or technical baccalaureate degree major;

Another career path is to pursue a vocational career after graduating from high school. (This may also be done in high school if appropriate vocational courses are offered.)

Finally, a student may take technology education for general education purposes in order to make him or her better prepared to live in a technological world.

## Exempli Gratia

TRIAD HIGH SCHOOL, Rural Route 1, St. Jacob, Ill. 62281. *Contact:* Robert Daiber, technology teacher.

A five-year technology education curriculum project at Triad has produced a comprehensive series of courses:

- *Technology Education I,* a one-year introductory course, covers four subject areas: communication, energy use, production, and transportation. In addition to acquiring basic technical skills in each of these areas, students learn about related social/cultural, economic, and ecological aspects. They learn to use equipment in the production lab to solve related technical problems; for example, using a compter to solve board-feet problems and determine cutting speed requirements.

- *Technology Education II* is a competency-based class that focuses on further developing students' technical understanding of tools, materials, and processes. One semester is devoted to metallics, the second to polymers. Each semester the student is required to complete a technical project that requires constructing a working model. Models of lasers, wind generators, solar planes, and self-propelled systems are a few of the models students have built.

- *Production Systems* provides students with an understanding of how production is managed. They organize a corporation to produce a selected product, using hands-on experience in various steps of processing materials into marketable goods. Students also have firsthand contact with day-to-day problems in manufacturing, such as making minor adjustments to a robot that places a sheet of plastic in an oven and then takes the heated sheet out and puts it on a forming mold.

- *Technological Systems* is an advanced, two-year course that involves research-based activities in communication, energy use, production, and transportation. In the first year of the course, time is set aside regularly for development of students' technical skills because those skills are important to the successful completion of their technology projects. The course also addresses the social, environmental, and economic aspects of technology so that at the end of the course students will have significantly raised their level of technological literacy.

HIDDEN VALLEY JUNIOR HIGH SCHOOL, 4902 Hidden Valley School Dr., SW, Roanoke, Va. 24018. *Contact:* Jerry Weddle, technology teacher.

Hidden Valley is involved in Virginia's statewide effort to teach contemporary technology education. The program uses the machines, tools, and materials that in times past were ends in themselves. Students still learn about machines, tools, and materials, but rather than building spice racks, bookshelves, or ceramic mugs, they learn about our technology.

A major group project is to design and build a model of some technological device. (Because of Weddle's experience at NASA, the projects have tended so far to deal with the technology of flight, but other fields are being examined.)

For each project, a company is organized, complete with a list of tasks and job titles. Students prepare resumes and apply for the jobs they wish to hold in the company. One company recently created a computerized flight simulator. Students can climb into their 8-ft. long carpeted airplane cockpit and learn the principles of flight. The flight simulator is complete to the extent that it provides for the sending of a telegram to next-of-kin in the event of a crash, with an explanation of why it happened!

EVERETT JUNIOR HIGH SCHOOL, 3900 Kipling St., Wheat Ridge, Colo., 80033. *Contact:* Les Litherland, technology teacher.

The technology program at Everett Jr. High combines research and development, problem solving, and decision making in an approach called "Year 2050." Students' activities include:

- *Media reviews:* Daily 10-minute reports about newspaper and magazine articles pertaining to technology.

- *Library visits:* Sessions with a media specialist that enable students to use the media center effectively, with emphasis on current technologies that affect our lives.

- *Visual "blasts":* Frequently changed displays that students are responsible for updating.

While collecting such information, students learn the rudiments of drafting, which they need as they proceed to the next step: creating scale drawings of what they see as some of the technological developments by the

year 2050. While any one of the four basic technology study areas can be used as the focus of this concept development, Litherland says that he has found transportation to be the most effective.

The planning and drawing stages are followed by construction of a model using tools, machines, and materials found in the shop — for the most part those tools available in traditional school shops.

When models have been completed, each student uses his or her drawings, research materials, and model to make a presentation to the entire class. Students also share in a wrap-up seminar, which among other things provides the young people with organization and communication experience.

COCKEYSVILLE JUNIOR HIGH SCHOOl, 10401 Greenside Dr., Cockeysville, Md. 21030. *Contact:* Donald Wright, technology teacher.

The Research and Experimentation in Industrial Arts program at Cockeysville Jr. High is one of the most exciting and challenging in the field. Each student carries out a research project of his or her own selection. The research always involves some form of construction and development and the use of testing facilities and procedures.

Students are required to prepare a research report that uses the components that are customary in sophisticated research reporting — problem, purpose, hypothesis, assumptions, limitations, procedures, etc. These reports are shared with other students in the class through student-organized and conducted seminars.

RICE LAKE PUBLIC SCHOOLS, Rice Lake, Wis. 54868. *Contact:* Robert Fisher, coordinator, technology education.

A technology education program, developed at both the middle school and high school level in Rice Lake, involves the Introduction to Technology course in the middle school, followed by a number of specialized courses in the high school in the areas of communications, construction, manufacturing, and power and energy. Students also have coursework in research and development, materials and processes, and electronic communication. Students in the manufacturing course have won the Stanley Tool contest in mass production.

New equipment that has been added to update technology education includes robots, lasers, computers, a satellite disk, and a programmable controller.

More advanced courses in areas such as contracting and provision for individual study are being developed.

# Additional Sources of Information

*Industry & Technology Education.* Technical Foundation of America, San Marcos, Tex., 1984. This publication provides the curriculum designer with an implementation guide synthesizing some of the latest ideas in the field of industrial arts/technology education.

*Math/Science/Technology Projects.* American Industrial Arts Assn., 1914 Association Drive, Reston, Va. 22091, 1985. Features selected projects in industrial arts/technology laboratories with the math/science emphasis illustrated in detail.

*Resources in Technology.* D.C. McCrory and G.R. Maughan, Davis Publications, Worcester, Mass., 1984. A book of activities related to engines and power, energy, communication, microelectronics, transportation, electric and hybrid vehicles, production, and robotics.

*Selected Questions on Teaching Technology Education.* D. Haley, AIAA, Reston, Va., 1984. Experienced teachers respond to a host of questions about organization and methodology; for instance, teacher preparation, types of classes best suited to starting a program, and control of construction activities.

*Standards for Technology Education.* W.E. Dugger, A. Bame, and C.A. Pinder. Goodheart-Willcox Co., South Holland, Ill., 1985. These standards can be used by classroom teachers, local and state supervisors, teacher educators, and school administrators to assess the quality of technology education programs.

*Technology Education: A Perspective on Implementation.* American Industrial Arts Association, Reston, Va. 22091, 1985. Part of this monograph has been adapted for this *Curriculum Report.*

*The Technology Teacher.* AIAA, Reston, Va. The Association's official journal, the publication is published eight times annually.

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